REMARKS

In the last Office Action, the terminal disclaimers filed with the last response were accepted. Claims 17-19 and 21-25 were rejected as being anticipated y Applicant's Admitted Prior Art ("AAPA"). Claim 26 was rejected as being obvious in view of AAPA. Claims 1-12, 14-16 and 20 were rejected as being obvious in view of AAPA and US Patent 5,156,321, ("Liburdi")

By this response, claims 1-12, 14-16 and 24 have been cancelled. Claims 17 and 26 have been amended to more specifically distinguish the claimed invention over the prior art.

Claims 1-12 and 14-16 have been cancelled to reduce the issues left herein to resolve. The claims remaining in the application are focused on the invention for forming a metal product, such as a cutting tool or kitchen knife, that has a superior cutting edge. Thus, applicant respectfully submits that the canceling of claims 1-12 and 14-16 will not place any undue burden on the patent office staff.

Claim 17 has been amended to make it clear that in accordance with the present invention the diffusion bonding between the coating material and the workpiece substrate is effective for retaining the wear resistant coating material on the cutting edge portion during an edge sharpening process of the cutting edge portion and during use of the cutting edge portion of the formed metal product. As will be further discussed herein, a major problem with the prior art has been the failure to retain a wear resistant material on

a cutting edge. The present invention overcomes this problem in a unique and non-obvious way. Claim 17 has been amended merely to make the distinction between the prior art and the present invention more clear than the previous wording of the claim, to avoid any chance of misunderstanding the patentable distinctions between the AAPA and the claimed invention. Accordingly, applicant respectfully submits that the amending of claim 17 will not place any undue burden on the patent office staff.

Claim 26 has been amended to remove the specific limitation of the formed metal product being a kitchen knife. This specific application for the inventive method has been presented herein as new independent claim 27. The claims remaining in the application have been narrowed to the specific invention of forming a metal product having a superior cutting edge. New claim 27 is directed to a specific application of the inventive method for forming a kitchen knife, this application of the present invention has been presented and examined already. However, new claim 27 includes the language added to claim 17 by this amendment which is intended to avoid any misunderstanding of the distinctions between the claimed invention and the prior art.

Claim 24 has been cancelled and rewritten as new independent claim 32. As stated above, the claims have been narrowed to focus on the inventive method for forming a metal product having a superior cutting edge as compared with any of the prior art. Claim 32 is directed to a specific application of the inventive method for forming a cutting tool, this application of the present invention has been presented and examined

already. Again, new claim 32 includes the language added to claim 17 by this amendment which is intended to avoid any misunderstanding of the distinctions between the claimed invention and the prior art.

As shown in Figures 2(a) through 2(d), the inventive method can be used for forming a cutting tool having a wear resistant surface. The inventive method can be employed to produce, for example, a long lasting cutting tool from a relatively inexpensive cutting tool substrate 10. For example, the tool substrate 10 may be a drill bit, end mill, lathe tool bit, saw blade, planer knifes, cutting tool inserts, or other cutting tool part. The substrate may, alternatively, be something other than a tool. For example, kitchen knives may be treated in accordance with the present invention to reduce the need for constant sharpening. (see, for example, pages 57 – 60 of the present specification).

In accordance with the present invention, a method is provided for forming a metal product having a cutting edge having a wear resistant surface. A workpiece substrate is provided having a cutting edge portion. A high-density coating process is used to coat at least the cutting edge portion of the workpiece substrate with a wear resistant coating material. A hot isostatic pressing treatment is performed on the coated workpiece substrate to obtain a metal product having a wear resistant surface comprised of the coating material. The wear resistant surface is formed at the cutting edge portion and has a diffusion bonding between the coating material and the workpiece substrate. Thus, in accordance with the present invention, a metal product can be formed that has a

cutting edge made of a long lasting, durable material that is diffusion bonded to a formed substrate.

As recited in the present claims, the diffusion bonding between the coating material and the workpiece substrate is effective for retaining the wear resistant coating material on the cutting edge portion. In accordance with the present invention, the wear resistant coating is retained by a vastly superior diffusion bond as compared with the coatings and brazing of conventional cutting tools (see, figures 12(a) and 12(b)). The diffusion bonded wear resistant coating is retained on the cutting edge portion of the workpiece substrate during an edge sharpening process of the cutting edge portion and during use of the cutting edge portion of the formed metal product.

The flaking off of the cutting surface is precisely the problem that the present invention addresses and effectively overcomes. As described in AAPA in the present specification, the prior art includes the forming of a coating material layer to provide the finished product with various surface attributes. For example, a wear resistant coating, such as Carbide, Cobalt, or TiN is often formed on cutting tools to provide wear resistance. Chemical Vapor Deposition is typically used to deposit a thin film wear resistant coating on a cutting tool substrate. For example, to increase the service life of a drill bit, chemical vapor deposition can be used to form a wear resistant coating of Cobalt on a high speed steel (HSS) cutting tool substrate. The bond between the substrate and coating occurs primarily through mechanical adhesion within a narrow bonding interface.

During use, the coating at the cutting surface of the cutting tool is subjected to shearing forces resulting in flaking of the coating off the tool substrate. The failure is likely to occur at the narrow bonding interface. (emphasis added, see the specification, pages 4 and 5).

In direct contrast, in accordance with the present invention, the diffusion bonding between the coating material and the workpiece substrate is effective for retaining the wear resistant coating material on the cutting edge portion in a manner that is superior to the conventional art. That is, the diffusion boding obtained using the inventive method creates a cutting edge that includes a wear resistant coating that will not flake off during an edge sharpening process of the cutting edge portion and during use of the cutting edge portion of the formed metal product.

By this invention, for example, a long lasting drill bit can be formed having a superior cutting edge integrally bonded to a preformed drill bit substrate. It often may not be practical to form the substrate out of the same material as the cutting edge. For example, high speed steel is a durable and relatively inexpensive material to use as a drill bit substrate, but does not hold a sharp cutting edge during use. A Cobalt, Carbide, TiN coating can be used to greatly improve the durability and usefulness of the cutting edge. Typically, such a coating will eventually flake or scrape off from the substrate. However, in accordance with the present invention, the cutting edge has an integrally formed

durable coating that is diffusion bonded to the substrate and is not susceptible to cracking or flaking off.

The AAPA related to high density coatings and HIP processing simply does not even remotely address the problem of the conventionally experienced loss of a wear resistant coating from a cutting edge. In fact, the AAPA related to cutting tools demonstrates the very need for the present invention since the conventional coatings or brazed material on a cutting edge are so subject to failure. There is not even the remote suggestion in any of the AAPA to the inventive process by which a diffusion bonding is created between a wear resistant coating material and a cutting tool that is effective for retaining the wear resistant coating material on the cutting edge portion during an edge sharpening process of the cutting edge portion and during use of the cutting edge portion of the formed metal product. The present claims make this distinction clear. Accordingly, the rejections based on anticipation and obviousness in view of the AAPA are believed to have been overcome.

The Examiner also cites Liburdi as teaching the use of a sintering process. However, the combination of the sintering process taught by Liburdi with AAPA still would not render the presently claimed invention obvious. With regards to cutting tools, the AAPA provides a coating process, such as Chemical Vapor Deposition, for depositing a wear resistant coating or a material, such as Cobalt, on a tool substrate. The bond between the substrate and coating occurs primarily through mechanical adhesion within a

narrow bonding interface. During use, the coating at the cutting surface of the cutting tool is subjected to shearing forces resulting in flaking of the coating off the tool substrate. The failure is likely to occur at the narrow bonding interface. The sintering process of Liburdi combined with the AAPA related to cutting tools would not address this problem. The AAPA that relates to high density coating and HIP processing simply has nothing to do with cutting tools, and there is no motivation in any of the prior art to forming a wear resistant coating on a cutting edge portion of a cutting tool in the manner defined in the present claims.

Accordingly, applicant respectfully submits that the claims of the present application are allowable over the prior art. In view of the foregoing, entry of this amendment, favorable reconsideration and allowance of the claims of the application are most respectfully requested. The Examiner is invited to contact the undersigned by telephone if there are any questions or suggestions regarding the present application.

Respectfully submitted,

March 1, 2002

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MAILING CERTIFICATE

Date of Deposit: 3/1/02

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17) A method of forming a metal product having a cutting edge having a wear resistant surface, comprising the steps of: forming a workpiece substrate having a cutting edge portion; performing a high-density coating process to coat at least the cutting edge portion of the workpiece substrate with a wear resistant coating material; and performing a hot isostatic pressing treatment on the coated workpiece substrate to obtain a metal product having a wear resistant surface comprised of the coating material, the wear resistant surface being formed at the cutting edge portion and having a diffusion bonding between the coating material and the workpiece substrate, the diffusion bonding between the coating material and the workpiece substarte being effective for retaining the wear resistant coating material on the cutting edge portion during an edge sharpening process of the cutting edge portion and during use of the cutting edge portion of the formed metal product.

26) A method of forming a metal product having a cutting edge according to claim 17; wherein the metal product formed comprises one of an ice skate blade, snow ski edge, pen tip and fishing hook.

27) A method of forming a kitchen knife having a cutting edge having a wear resistant surface, comprising the steps of: forming a knife substrate having a cutting edge portion; performing a high-density coating process to coat at least the cutting edge portion of the

knife substrate with a wear resistant coating material; and performing a hot isostatic pressing treatment on the coated knife substrate to obtain a kitchen knife having a wear resistant surface comprised of the coating material, the wear resistant surface being formed at the cutting edge portion and having a diffusion bonding between the coating material and the knife substrate, the diffusion bonding between the coating material and the knife substrate being effective for retaining the wear resistant coating material on the cutting edge portion during an edge sharpening process of the cutting edge portion and during use of the cutting edge portion of the formed kitchen knife.

28) A method of forming a kitchen knife having a cutting edge according to claim 27; wherein the step of performing the high-density coating process comprises performing a hyper velocity oxy-fuel thermal spray process.

29) A method of forming a kitchen knife having a cutting edge according to claim 28; wherein the step of hot isostatic pressing treating comprises the step of heating the coated cutting tool substrate to a temperature that is substantially 80% of the melting point of the coating material; and pressurizing the coated cutting tool substrate to a pressure substantially between 20 and 50 percent of the yield strength of the coating material in an inert gas atmosphere.

30) A method of forming a kitchen knife having a cutting edge according to claim 29; further comprising the step of performing a sintering heat treatment on the coated knife substrate to remove entrapped gas in the coating material before performing the hot isostatic pressing treatment so that the formed kitchen knife has a relatively smooth surface texture.

31) A method of forming a kitchen knife having a cutting edge according to claim 27; wherein the coating material comprises a hard and durable metal such as Cobalt, Carbide and TiN.

32) A method of forming a cutting tool having a cutting edge having a wear resistant surface, comprising the steps of: forming a cutting tool substrate having a cutting edge portion; performing a high-density coating process to coat at least the cutting edge portion of the cutting tool substrate with a wear resistant coating material; and performing a hot isostatic pressing treatment on the coated cutting tool substrate to obtain a cutting tool having a wear resistant surface comprised of the coating material, the wear resistant surface being formed at the cutting edge portion and having a diffusion bonding between the coating material and the cutting tool substrate, the diffusion bonding between the coating material and the cutting tool substrate being effective for retaining the wear resistant coating material on the cutting edge portion during an edge sharpening

process of the cutting edge portion and during use of the cutting edge portion of the formed cutting tool.

33) A method of forming a cutting tool having a cutting edge according to claim 32; wherein the step of performing the high-density coating process comprises performing a hyper velocity oxy-fuel thermal spray process.

34) A method of forming a cutting tool having a cutting edge according to claim 33; wherein the step of hot isostatic pressing treating comprises the step of heating the coated cutting tool substrate to a temperature that is substantially 80% of the melting point of the coating material; and pressurizing the coated cutting tool substrate to a pressure substantially between 20 and 50 percent of the yield strength of the coating material in an inert gas atmosphere.

35) A method of forming a cutting tool having a cutting edge according to claim 34; further comprising the step of performing a sintering heat treatment on the coated cutting tool substrate to remove entrapped gas in the coating material before performing the hot isostatic pressing treatment so that the formed cutting tool has a relatively smooth surface texture.

36) A method of forming a cutting tool having a cutting edge according to claim 32; wherein the coating material comprises a hard and durable metal such as Cobalt, Carbide and TiN.